RESTRICTED CIRCULATION

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Agricultural Memorandum No 506
L D J Harvey

AN INITIAL COMPARISON OF SPRING BARLEY YIELDS WITH WEATHER PARAMETERS

1. Soils Science branch of ADAS having investigated the seed bed conditions for spring barley for 1972, and finding it a 'bad year', were expecting poor yields. In fact, quite the reverse happened, the yields were approximately 33 1/3% up on the two previous years at a typical site (Morley ST. Botolph, Norfolk).

ie 1972 ..... 32.0 cwts/per acre
1971 ..... 23.8 cwts/ per acre
and 1970 ..... 24.2 cwts/per acre

It was decided to look at weather aspects, in conjunction with growth and yield data, for the 3 years 1972, 1971 and 1970, at Morley St Botolph - both weather and crop information being readily available.

2. Although the crops for the three years investigated were ready for harvesting on approximately the same date (4 day spread), the sowing dates were vastly different (33 day spread), as too, were the dates of the earlier growth stages. (see fig. 1).

One possible reason for the large spread in sowing dates was the difference in soil temperatures (at 30 cm) in the 3 years. Possibly waiting for the soil temperature to reach 6°C (the temperature thought a minimum for germination) was deliberate - certainly this coincided with each of the sowing dates (see fig. 6).

Another possible reason was the rainfall distribution and the distribution of workdays in the 3 years. This was not examined.

3. Because of the difference in length and times of the growing periods for each year, a general comparison of the whole growing season was unrevealing.

The weather parameters were then compared, each accumulatively against the various growth stages (Feekes Scale).

The following points were then noticed:-

(a) From fig. 2 it can be seen that 1972 was ahead on sunshine throughout the growing period. Although 1971 passes 1970 between growth stages 11_1 and 11_2 (the ripening stages, mainly a drying process) it would appear it was too late to effect the yield.

(b) Figs 3 + 5 show rain and Soil Moisture Deficit..

The Soil Moisture Deficit is based on a model of water usage as follows-

During April, and before any effective crop cover is established, it is assumed that the top layers of soil may lose up 0.5 inches at the potential transpiration rate.

During May and thereafter the first 3 inches of water available from soil reserves are assumed to be extracted at the full potential rate.

The next 5 inches of soil moisture (from the lower soil horizons) are assumed to be extracted at 45% of the potential transpiration rate.

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A total extraction of 3 + 5 = 8 inches is assumed to be the maximum soil moisture deficit.

By the beginning of August, the effective transpiration of the standing crop is assumed to be zero, excepting wet summers (and an - implied slow maturing crop) when transpiration may proceed until the middle of August.

Incoming rainfall is used preferentially before deep soil moisture reserves are called on.

The justification for this model comes from detailed observations carried out by the Meteorological Office at the Plant Breeding Institute, Cambridge.

Consulting these two figures shows that rain was steadily available throughout 1972 and that the crop was never under any stress due to soil moisture deficit. 1971 and 1970 both show approximately the same deficiency in the earlier growth stages. 1971 improves from growth stage 5, but it is thought by this time that the SMD would have to be very large to be important.

The reason for this thinking, is based on other investigations into root depth now being carried out. Basically information so far available would point to

(i) depth of root could be of the order of 15 cms 30 days from planting.

(ii) by growth stage 5 total root depth could be of the order 60-70 cms.

(iii) by stage 8, 100 cms +.

When considering the above information it must be borne in mind that although roots grow to greater depths they are then mainly following fissures in the ground and the functioning of these long roots in drawing up of moisture and nutrients is hard to determine.

Also that, considering a root of depth 42.5 cm

(a) 1st 12.5 cms contain 60% of the root ~~from 12.5 to 22.5 cm~~
from 12.5 to 22.5 cm contains 19% of the root
" 22.5 " 32.5 " " 6% " " "
" 32.5 " 42.5 " " 14% " " "

Therefore 79% of the root is in the top 22.5 cms.

(b) Figure 4, accumulation Potential Transpiration follows the same pattern as that of fig 2 (sun). If the final stages of growth (11 onwards) are ignored then the yields are proportional to the accumulative P.T.

4. In conclusion it is thought that this investigation shows substantial difference in weather factors, between years of high and moderate yields. Also that it is worth inquirying whether the same weather factors are brought out by independent data of other years and other sites. With the more important factors identified for each growth stage, the way is perhaps open for a quantitative study of the relation between weather and yield in barley.

Meteorological Office
Cambridge
October 1972

COMPARISON OF TIMES OF DIFFERENT GROWTH STAGES FOR 'PROCTOR' SPRING BARLEY, GROWN AT MORLEY ST. BOTOLPH IN 1970, 1971 AND 1972.

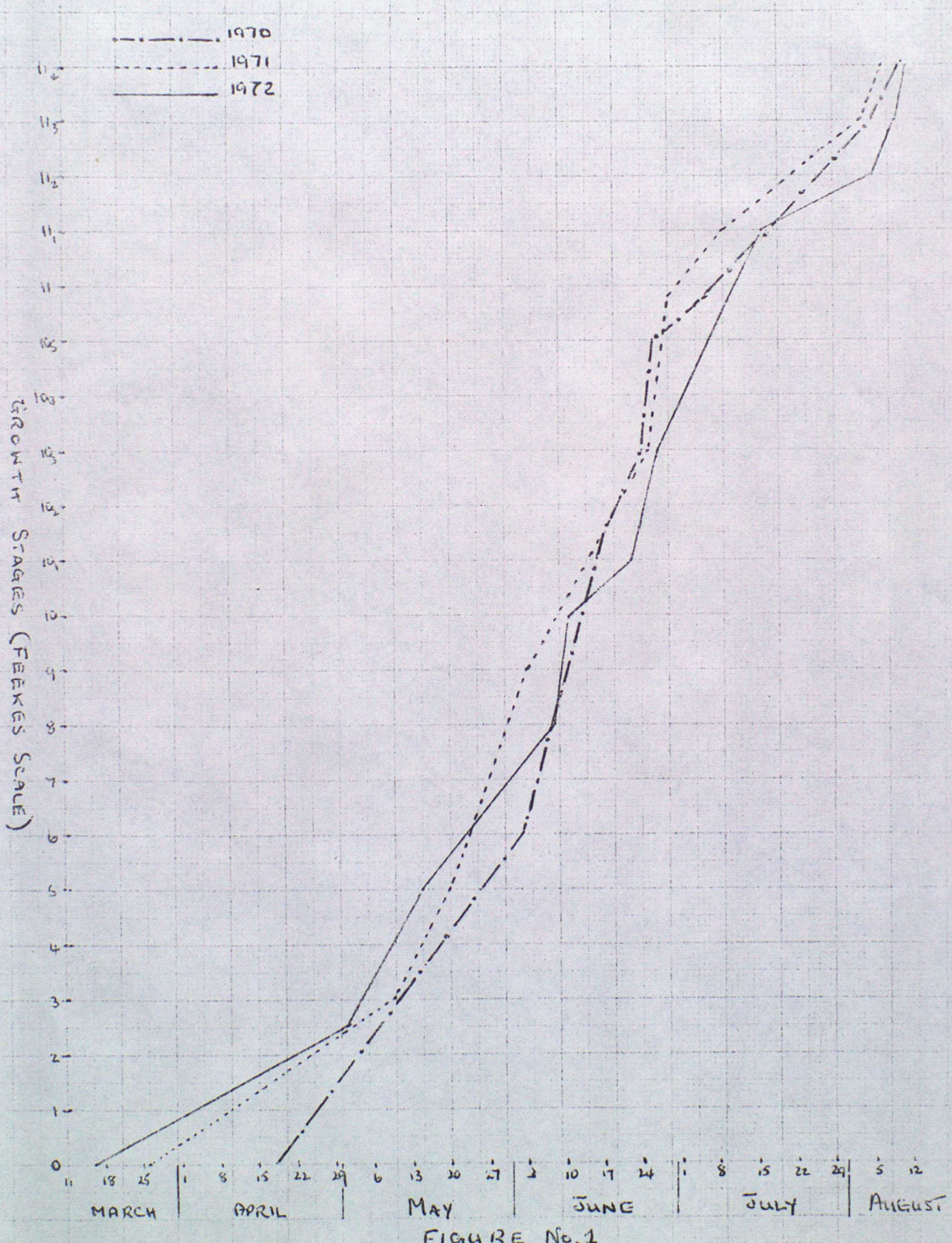
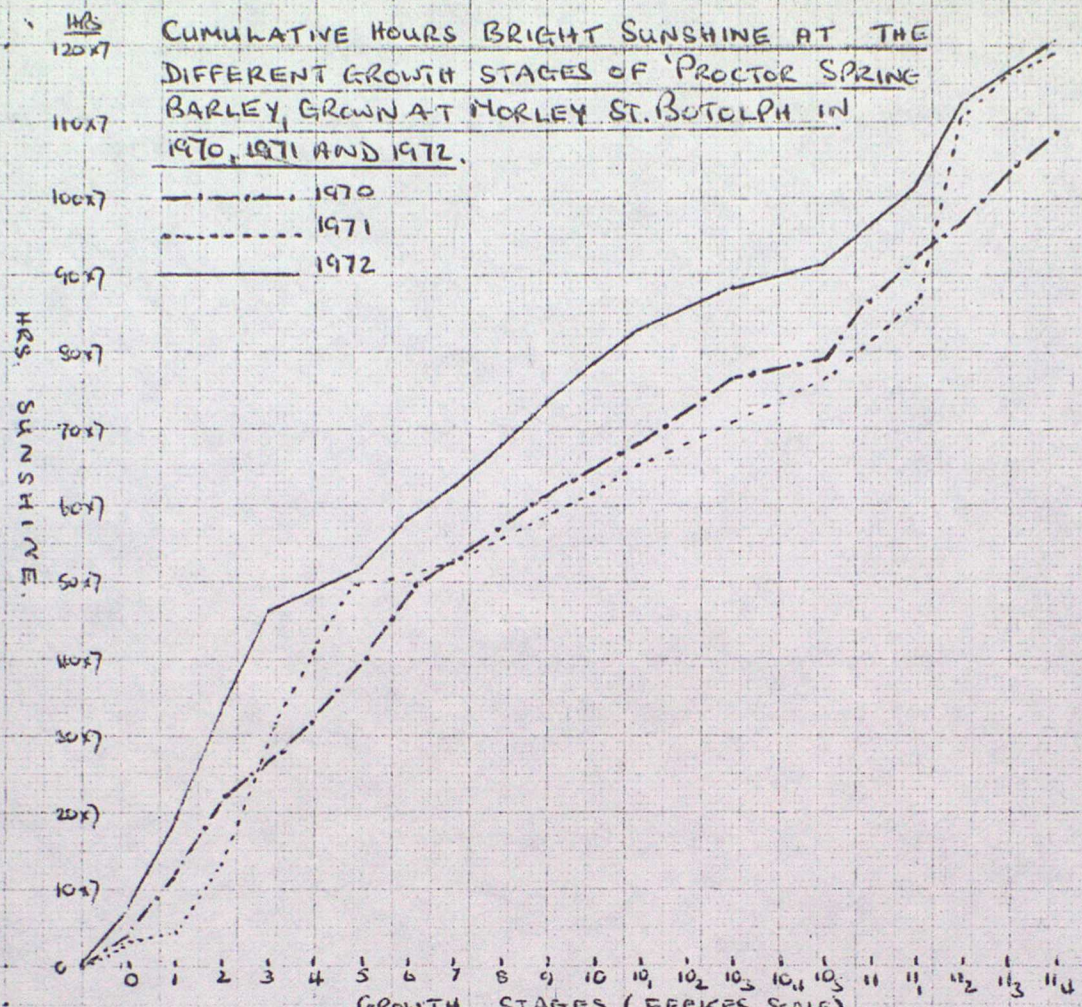


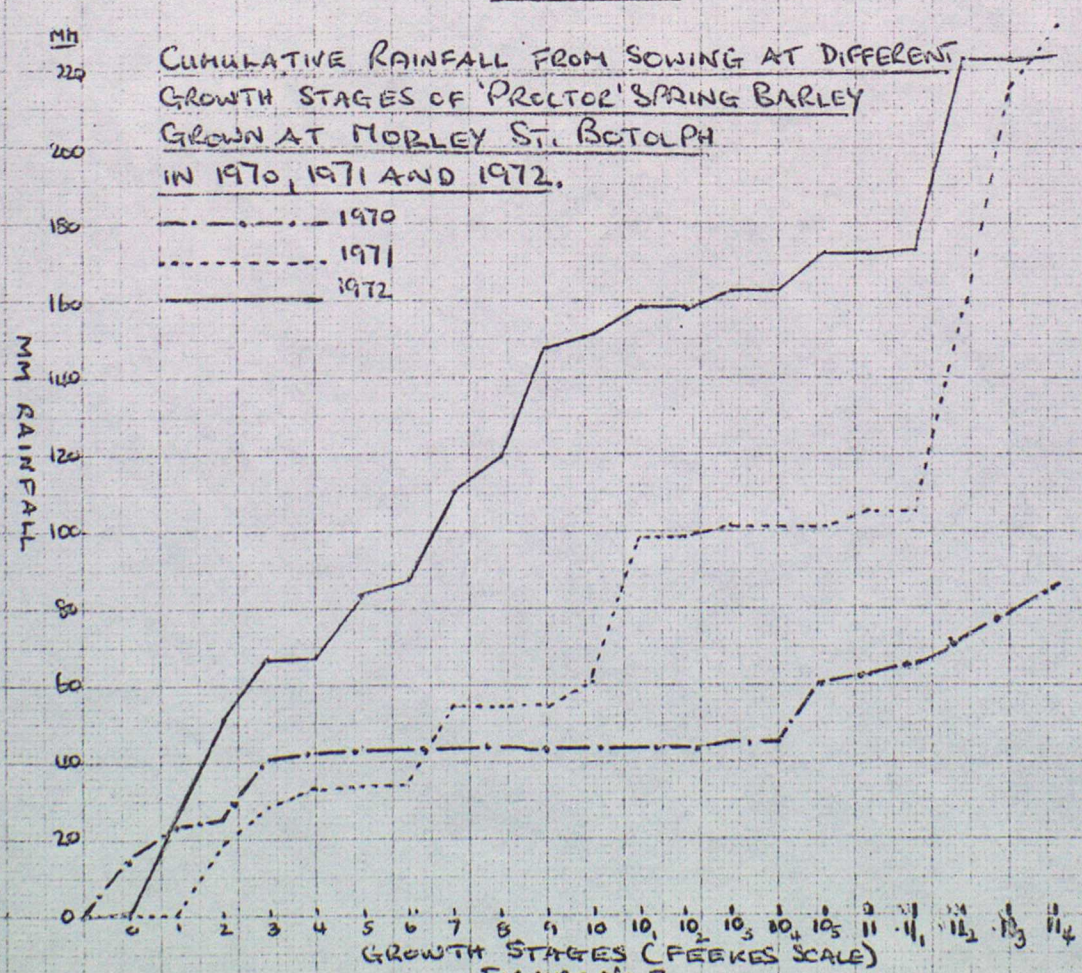
FIGURE No. 1



CUMULATIVE HOURS BRIGHT SUNSHINE AT THE DIFFERENT GROWTH STAGES OF 'PROCTOR SPRING BARLEY, GROWN AT MORLEY ST. BOTOLPH IN 1970, 1971 AND 1972.

—·—·—·— 1970
····· 1971
———— 1972

FIGURE No. 2



CUMULATIVE RAINFALL FROM SOWING AT DIFFERENT GROWTH STAGES OF 'PROCTOR' SPRING BARLEY GROWN AT MORLEY ST. BOTOLPH IN 1970, 1971 AND 1972.

—·—·—·— 1970
····· 1971
———— 1972

FIGURE No. 3

CUMULATIVE PT. FOR DIFFERENT GROWTH STAGES OF 'PROCTOR' SPRING BARLEY, GROWN AT MORLEY ST. BOTOLPH. IN 1970, 1971 AND 1972.

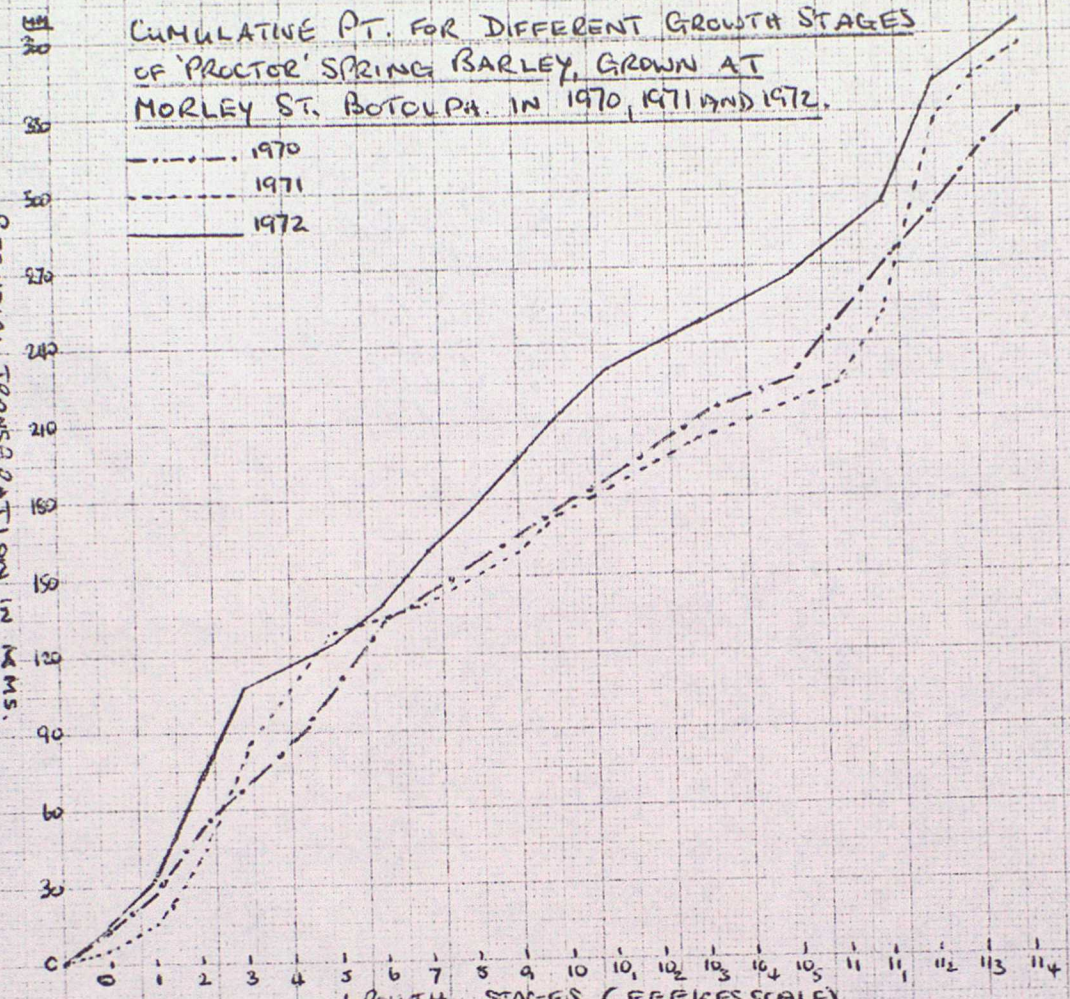


FIGURE NO. 4

S.M.D. AT DIFFERENT GROWTH STAGES FOR 'PROCTOR' SPRING BARLEY, GROWN AT MORLEY ST. BOTOLPH. IN 1970, 1971 AND 1972.

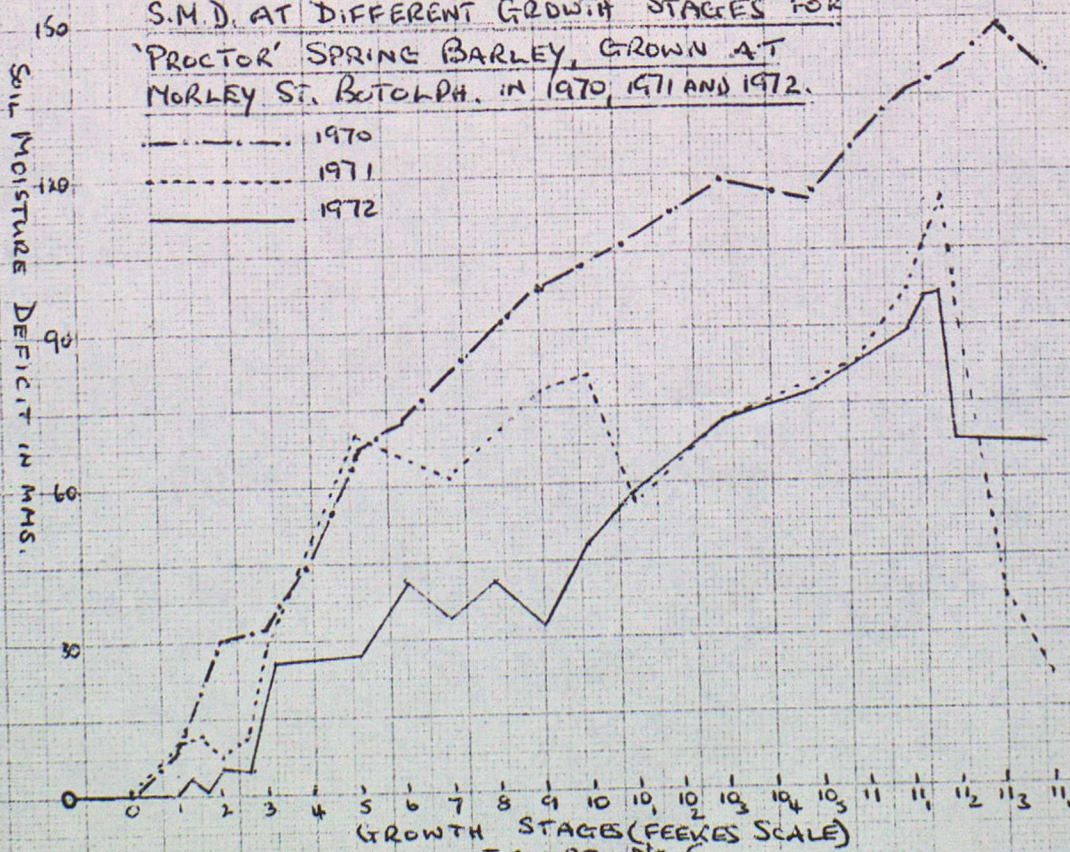
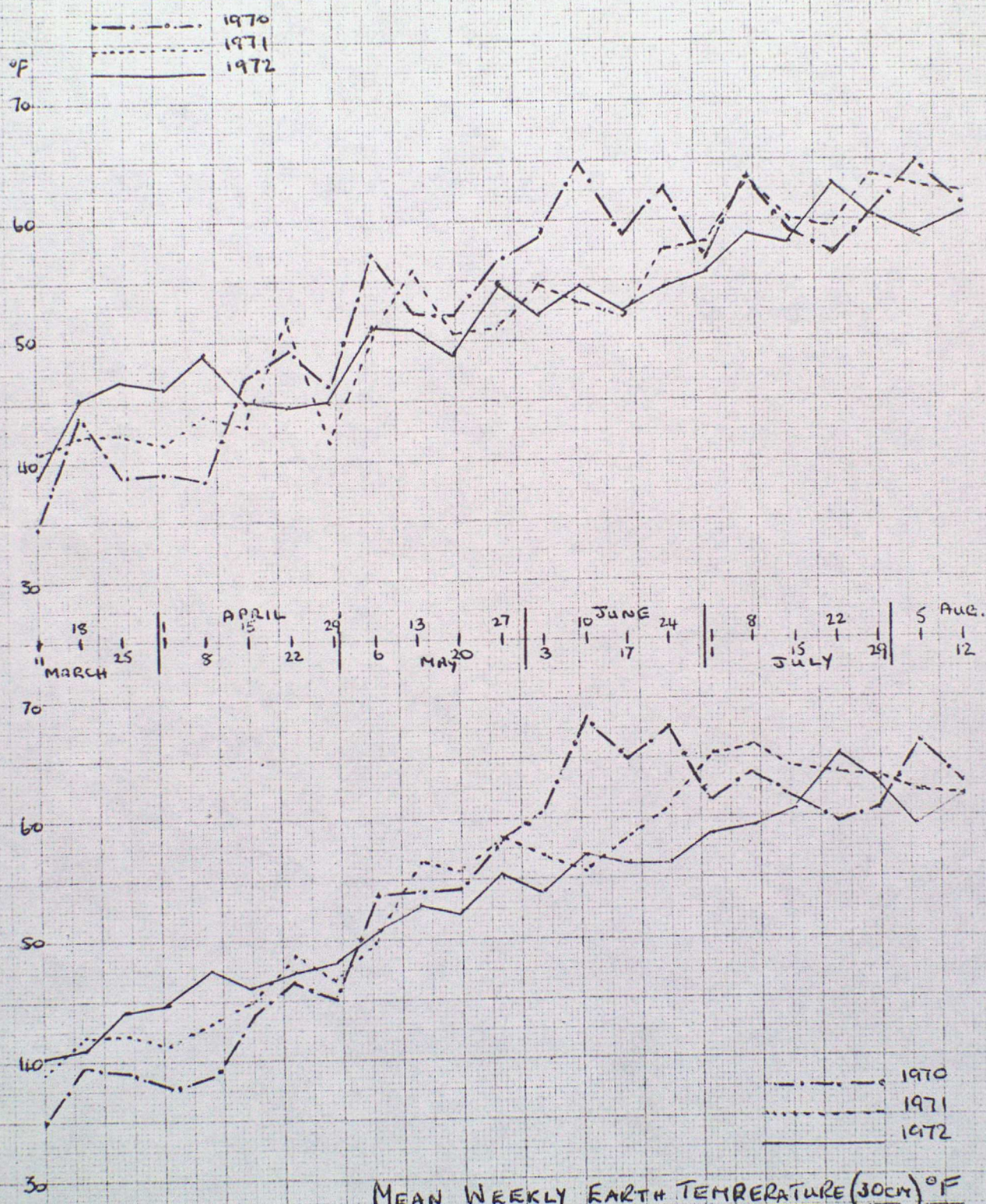


FIGURE NO. 5

MEAN WEEKLY AIR TEMPERATURE °F

FIGURE No 6



MEAN WEEKLY EARTH TEMPERATURE (30CM) °F